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# Intense Toxicity and Effects of Malathion Pesticides to Fresh Water Prawn Macrobrachium Dayanum

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Acute Toxicity, Macrobrachium dayanum, LC50, Malathion

## Abstract
Pesticide toxicity poses a serious hazard to aquatic creatures and their habitat. At a fatal dose (LC50) of 8.0 mg/L, malathion was discovered in the current investigation to be acutely poisonous to Macrobrachium dayanum. For sublethal investigations, 0.8 mg/L, or one-tenth of the LC50 value, was used. Lethal concentration values (LC50) are falling. The shrimp exhibited odd behaviour such as irregular and choppy swimming, efforts to leap out of the water, surfacing and repeated swallowing, reduced opercular movement, and excessive mucus production all over the body. The effectiveness of aquatic ecosystems and the level of pollution may both be monitored through this monitoring.

## 1. Introduction

Pollutants of many different kinds are a problem for the environment. One such pollutant, pesticide, is crucial in preventing different species of insects from damaging crop plants. Pesticides used in crops indiscriminately provide substantial environmental risks to aquatic and terrestrial wildlife. Unfortunately, the majority of pesticides do not biodegrade and can stay in the soil and water for a very long time (Verma et al., 2022). The toxicity of pesticides on several species of shrimp has been the subject of numerous publications (Sharma, 1991, Shivaji and Mangaise, 1967, Wildish, 1971). Intense toxicity caused by different types toxic substances in freshwater shrimp can be assessed by quantitative parameters such as survival and mortality of test animals and the susceptibility of different shrimp species to metal toxicity. Shrimp poisoning is the culmination of a series of events involving various physical, chemical and biological processes. The LC50 is an indicator of the resistance level of a population's response to metals (Reda, et al., 2010). Malathion is a broad-spectrum aliphatic insecticide extensively used for domestic and commercial agriculturaliy purposes. Malathion is commonly used in Indian agricultural land area. The indiscriminate use of these pesticides in crop fields contaminates the aquatic environment, affecting the aquatic organisms. Several scientists have already conducted studies on the effects of malathion on farmed shrimp species. But studies on the effects of malathion on this shrimp are scarce. Here we attempt to study the lethal toxicity of malathion in M. dayanam. As these are suitable for monitoring prawn toxicity (Ashraf et al., 1992; Nair and Sheriff, 1998). *M. dayanum* shrimp is an important staple and main cultured freshwater shrimp commonly found in rivers, ponds and reservoirs (Dubey and Hoseti, 2010) and popular in India.

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## 2. Methodology

**Physico-chemical Analysis of Water:**

APHA (1995) analyzed the water in terms of physico-chemical parameters. The following parameters were analyzed during the duration of the experiment.

Physico-chemical properties of water like temperature, pH, dissolved oxygen (DO), total dissolved solids (TDS), total alkalinity of water, chloride (Cl) were determined following the standard methods given by (Welch, 1952). (Trivedi and Goyal, 1984), (Wetzel & Likens, 1991) and (APHA, 2005).

**Analysis of Temperature**

Temperature:

In a well-established system, water temperature regulates the speed of all chemical processes and has an impact on shrimp immunity, development, and reproduction. Extreme temperature swings may be a con.

pH :

Allow the pH metre to warm up for a while, then standardise it with three pH buffer solutions. After that, get a sample of water that is around 30 ml in size and note the pH level. The quantity of salt (ion) present directly affects the electrical conductivity, which is measured in dsm-1 units. The electrical conductivity metre should be calibrated with 0.01 N KCl, and the conductivity of the water sample should be recorded in dsm-1 (Tables 1 and 2). An electrical conductivity metre may be used to calculate the total soluble salts from a water sample. The quantity of salt (ion) present directly affects the electrical conductivity, which is measured in dsm-1 units. Concentration of salt (mg L-1) equals E.C. (DS M-1) at 250 C multiplied by 640 (Table 1).

**Determination of Free Carbon Dioxide:**

When CO2 dissolves, it can result in a weak carbonic acid solution that alters the pH of water and increases alkalinity and hardness by causing minerals to dissolve. The released CO interacts with either NaOH or Na2CO3, forming Na (HCO3) 2. When phenolphthalein indicator is present and the pH is 8.3, the reaction is said to be complete when a pink hue appears. In a conical flask, place 50 ml of the material to be analyzed. Phenolphthalein indicator should be added in 4–5 drops. If the sample is pink and opaque, titrate it with ordinary 0.02 N NaOH until a light pink hue appears and lasts for 30 seconds and keep track of the burette reading.

**Dissolved Oxygen:**

The metabolic activities of living things depend on oxygen, which is involved in several significant biological events. The greatest indicator of the impact of pollution in water bodies is thought to be dissolved oxygen. The BOD test, on which it is based, assesses primary production.

Divalent manganese in its higher valence is oxidised by oxygen in the water sample and precipitates as brown hydrated oxide when strong alkaline azide solution is added. Following acidification, manganese returns to its divalent form and releases iodine in an amount according to the sample's DO level. With N/40 sodium thiosulfate solution, the released iodine is titrated using starch as an indicator.

In a BOD container, the sample was obtained (300 ml). Add 2 mL of the alkaline-azide reagent, 2 mL of the MnSO4 solution, and 2 mL of the mixture to the sample. When including these chemicals to the sample, use a different tapered volumetric pipette. Put the lid on the bottle and shake it vigorously a few times to thoroughly combine. Allow to precipitate, producing a brownish-colored bottom layer and a clear top layer. Add 2 ml of concentrated H2SO4. To completely dissolve the precipitate, thoroughly combine. The titration following acidification can be postponed for a few hours if required without affecting the results. Transfer 200 mL of the sample to a conical flask, and then titrate with 0.025 N or N/40 Na2S2O3 solutions until a very light yellow (straw) hue is seen. Until the initial disappearance of the blue (colorless endpoint), add a few drops of starch indicator solution, and then keep titrating (Table 1).

**Total Hardness (Ca+2 + Mg+2):**

50 mL of the sample should be added to a conical flask to determine the total hardness. Half a tablet of

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the total hardness indicator should be added after 1 mL of the buffer solution. The colour will be wine red. Keep the pH at 10 +/- 0.1. Drops of 4N NaOH should be added. Titrate the wine-red hue with a 0.01 M EDTA solution until it becomes blue (end point). Round your calculations' outcomes to the closest full number (Table 1).

**Total alkalinity**

A 50 mL sample volume was titrated against 0.02 N H2SO4 in the presence of the phenolphthalein indicator until the pink hue vanished in order to estimate the phenolphthalein alkalinity. The quantity of titrant used was recorded. The same sample is then titrated with 0.02 N NaOH in the presence of methyl orange indicator until the color shifts from yellow to orange in order to estimate total alkalinity (i.e., alkalinity owing to OH, CO, and HCO). Went. It was noticed how much titrant was used overall.

If, however, no pink development was seen following the addition of the phenolphthalein indicator, the sample was put through the sampling process before the addition of the methyl indicator as stated above for total alkalinity. Following that, the formula shown below was used to compute the total alkalinity (T) and phenolphthalein alkalinity (P).

Phenolphthalein alkalinity (P) as mg / 1 CaCO3 = Vol. of titrant used × 1000

vol.of the sample

Total alkalinity (T) as mg / l = Total vol.of titrant used × 1000

Sample vol.

**Calcium hardness:**

An aliquot of water sample was used for this, and it was treated with N/10 NaOH and then a pinch of mure-oxide indicator before being titrated against 0.01M EDTA solution until a color changed from salmon pink to purple end point. The amount of titrant used was measured once the titration was terminated. Following that, the calcium hardness was determined using the following formula:

Calcium hardness as mg / l CaCO3 =

Volume of titrant used ($V_2$) x1000 × 1.05 (mol. Wt. of CaCO3)

sample Volume

The physico - chemical parameters of the experimental medium were regularly

Monitored during the study period following the standard methods (Jhingran *et al*., 1969).

**Acute toxicity study (LC 50)**

The bioassay techniques used in the current study were the same as those used in (Nikam et al. 2011). M. diyanum specimens that were gathered in Madhya Pradesh's Bhopal in Ret Ghat and Upper Lake. They were initially housed in prawn tanks with a constant, mild flow of dechlorinated tap water. Prior to the trial, they were acclimated in tanks for a week while being given a commercial meal. To preserve the biomass hypothesis, the laboratory-acclimatized prawns were divided into batches of 30 and housed in 35 l glass tanks with dechlorinated tapwater (1 g l). In order to prevent hypoxic conditions that could possibly affect toxicity, the water in the tanks was aerated. In order to prevent the effects of fasting on regular physiological processes, the animals were given the same commercial meal throughout the study period. Five concentration distincts of Malathioan (10–50 ppm) and ~~Dicloroves (10–50 ppm) were chosen~~ for LC 50-1 determination. 30 prawns were used for each concentration, exposing one at a time in a 50 l glass tank. To uphold the biomass idea, this method was used throughout the inquiry. Six times each experiment was run at the chosen malathion, recording each time how many prawns were killed at each concentration for up to 96 hours. To avoid any hypoxic conditions, the tanks housing the control and experimental prawns were continuously aerated.

By using a visual approach in which the probit mortality was plotted against the log concentration of Malathion and Dicloroves, the average mortality in each concentration was chosen to establish the LC 50. M. dyanum prawn value from this approach in

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the current investigation, a sublethal dose was used for the experiment.

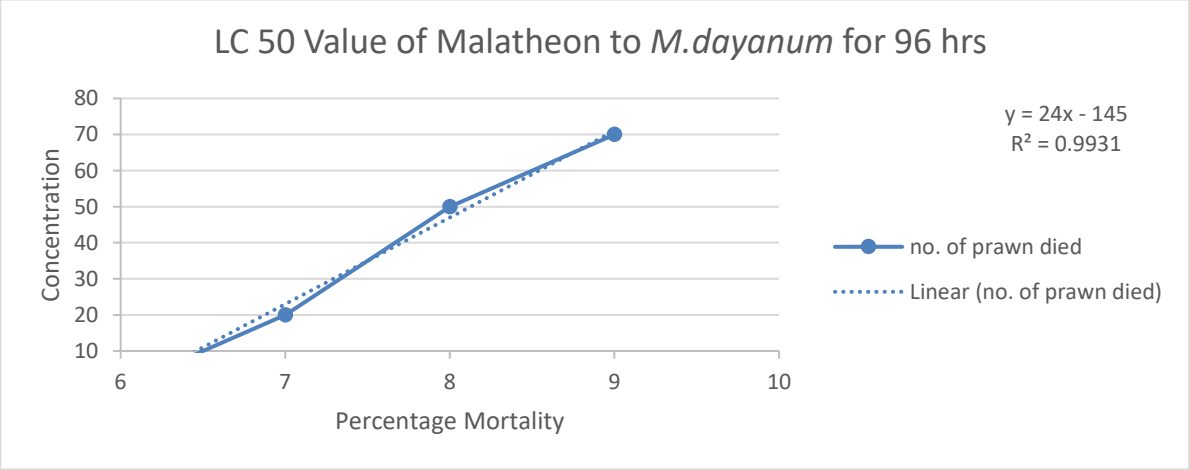
## 3. Results and Discussions

**Physiochemical Analysis:**

**Table.1:** Physicochemical parameters of water used in experiments

| Parameters | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Days** | **Temperature** | **pH** | **DO** | **Free $Co_2$** | **Alkalinity** | **Hardness** | **Calcium Hardness** |
| **1** | **32** | **7.5** | **5.6** | **2** | **36** | **284** | **90.3** |
| **15** | **29** | **7.3** | **6.4** | **4** | **34** | **312** | **54.2** |
| **30** | **30** | **7.2** | **8.0** | **4** | **26** | **278** | **47.46** |
| **45** | **26** | **7.3** | **7.6** | **4** | **42** | **265** | **45.65** |
| **60** | **25** | **7.2** | **8.4** | **2** | **42** | **236** | **43.59** |
| **75** | **24** | **7.6** | **8.0** | **3** | **40** | **243** | **36.45** |
| **90** | **26** | **7.4** | **8.4** | **4** | **44** | **281** | **77.65** |

Lc50 Value of Malatheon:




When *M. dyanum* prawns were exposed to harmful levels of malathion, distinct behavioral alterations were seen. At lethal concentrations (9.0 l/L), they attempted to escape the toxicant (Malathion) by swimming erratically, moving quickly with their opercles, becoming restless, often surfacing, gulping air, swimming upside down, and extending their fins. The profuse discharge of ovary and hepatopancreas was a significant local consequence. When the prawn was pointed towards the water surface, air bubbles on the surface of the water indicated the suffocation of the shrimp exposed to malathion. They eventually lost their balance and fell to the bottom, dead. On the *M. dyanum* prawn's

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open mouth, the deceased creatures were displayed inverted.

Malathion was reported to suppress acetyl cholinesterase activity in the muscle, ovary, and hepatopancreas tissues of the prawn *M. dyanum* at sub-lethal concentrations (Abdel-Halim et al. 2006). In the hepatopancreas of prawns exposed to various environmental contaminants, malathion increases the activation of aromatic amines (Versteeg, et al., 1999).

The control prawns, according to (Schroer et al., 2004), acted in a normal way by being active and moving with coordination. They displayed irregular, erratic, and darting swimming motions and loss of balance in the toxic environment, which is caused by inhibition of activity that accumulates malathion in cholinergic synapses and results in hyperstimulation by the environment (Daam, et al., 2009).

The findings of my research demonstrate that malathion may be classified as somewhat harmful to prawns. According to (Van den Brink et al., 2006), behavioural changes such irregular swimming, restlessness, and surfacing might represent an avoidance response to the narcotic effects of heavy metals or a change in the sensitivity of chemo-receptors. Different ammonia concentrations caused fresh water prawn motility to slow down and become drowsy with frequent surfacing (Rico et al., 2010). Malathion toxicity in *M. dyanum* measured at 96 hours was 9.0 l/L. Below the malathiom concentration of 8 mg l-1 in *M. dyanum*, no mortality was seen.

However, the concentrations of 9.0 µl/L and above were observed to be toxic. The 95% confidence limits were 1.92 mg l - 1 (lower limit) and 1.96 mg l -1 (upper limit) mg l -1 in *M.dyanum*. The slope function calculated of test animal was 9.0 µl/Lrespectively. For *M. dyanum* subjected to hazardous levels of malathion, a positive correlation co-efficient between the concentrations of the chemical and the death rate was found, and it was statistically significant ($r = 0.9878$; $P < 0.01$) According to Krishnapriya et al. (2014), the deadly concentration of chromium at 96 hours (LC50) was found to be 3.5 ppm for *M. dyanum* and the lethal concentration of rimon at 98 hours (LC50) was reported to be 3.322 ppm for *M. dyanum* (Schroer et al., 2004). (Sarma et al., 2007).

## 4. Conclusion

It may be concluded that the prawn exhibited uncouth behaviour, including jerky, irregular swimming, attempts to leap out of the water, repeated air gulps, reductions in opercular movement, and excessive mucus production all over the body. The effectiveness of the regulatory mechanisms in shrimp exposed to malathion was demonstrated by the chosen tissues under this monitoring, which may be used to monitor the quality of aquatic environments and the level of pollution.

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